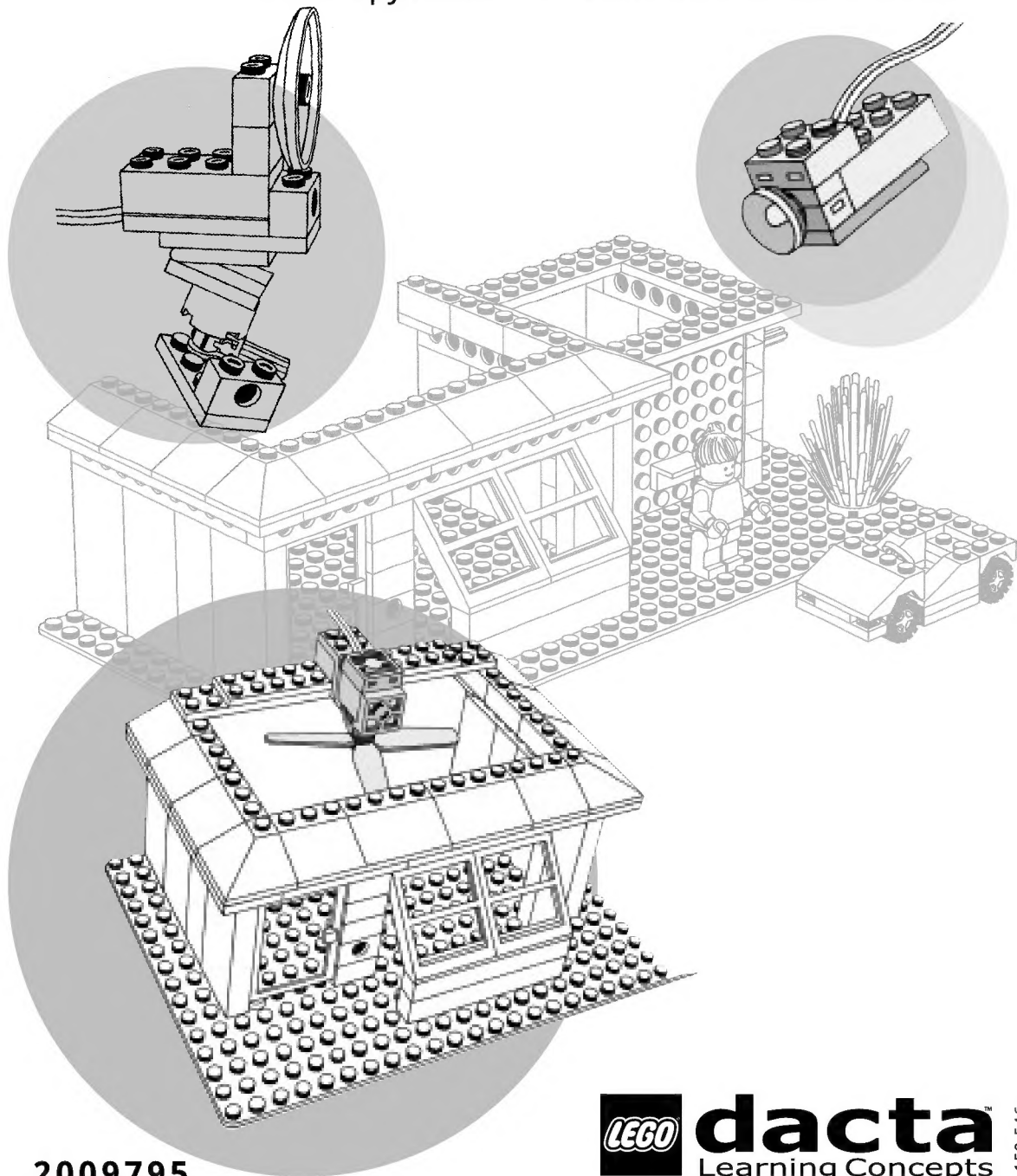


LEGO® MINDSTORMS™

F O R S C H O O L S

INTELLIGENT HOUSE SET

LEGO DACTA™ Robotics System Teacher Notes
and Copymasters for LEGO DACTA Set # **9795**



2009795

LEGO **dacta**
Learning Concepts

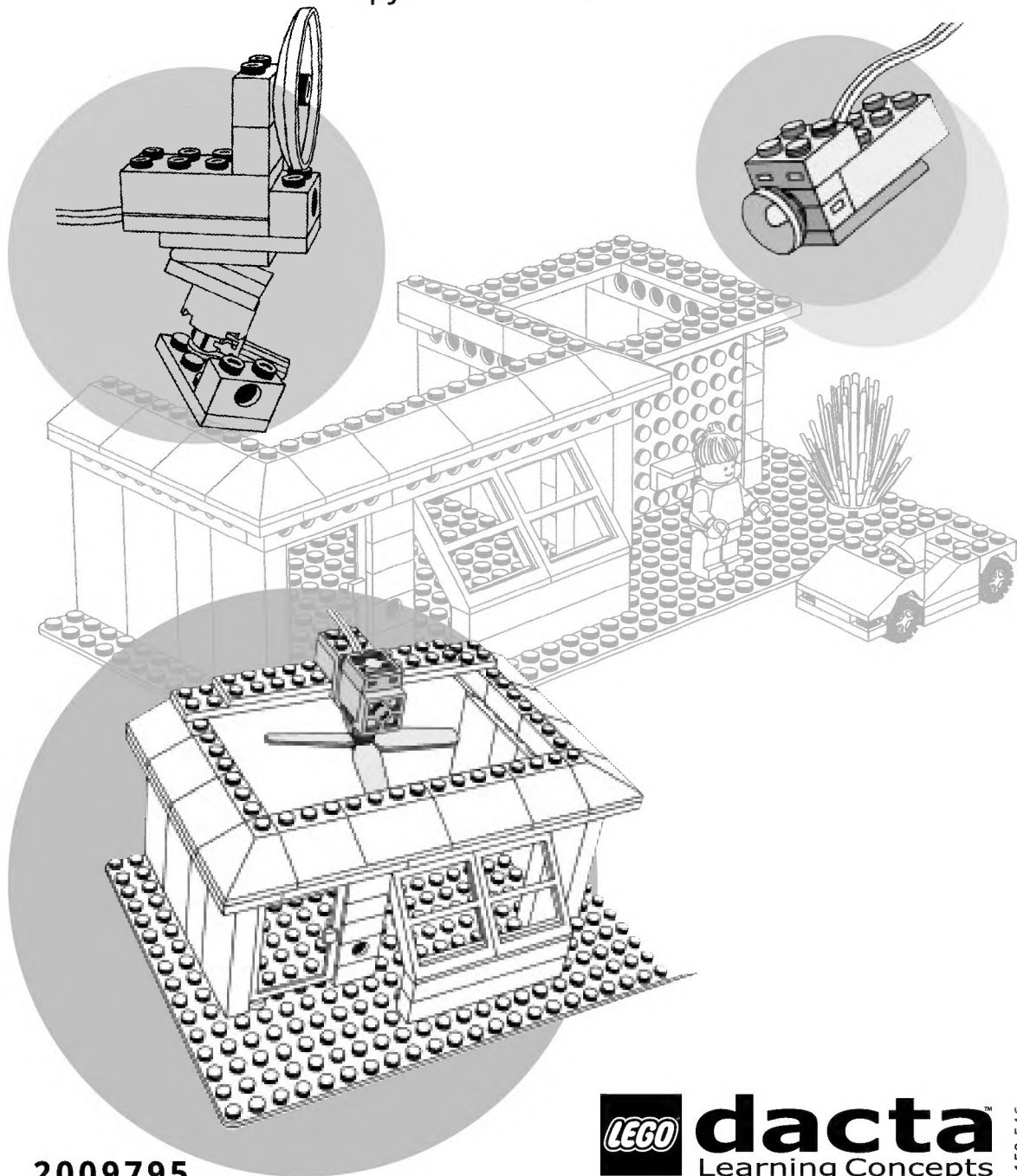
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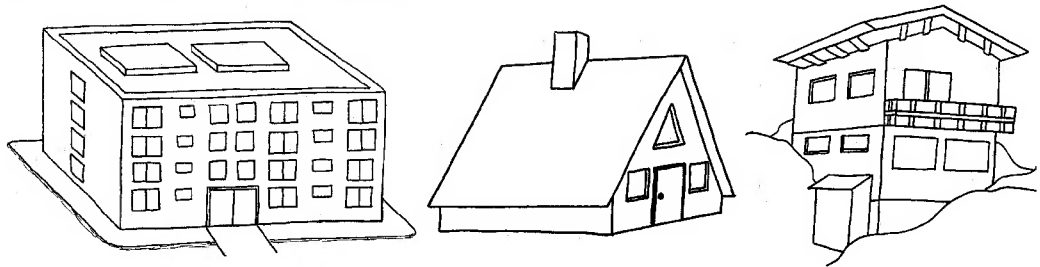
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<http://www.lego.com/dacta>

INTRODUCTION

Welcome

Welcome to **ROBOLAB™** and the Intelligent House set. This project set is part of the LEGO DACTA **ROBOLAB** system. **ROBOLAB** Intelligent House set builds on the skills and knowledge learned in the **ROBOLAB** Starter Set. If you and/or your students have not prior experience with **ROBOLAB**, see page 4 for further assistance.



Interdisciplinary Approach

LEGO DACTA **ROBOLAB** — LEGO MINDSTORMS for Schools — gives your students the power to explore and learn important interdisciplinary skills and knowledge through designing, making, programming and testing autonomous LEGO robots.

With the Intelligent House Set, students work together on models and problem solving projects that relate to the same overall theme. During this process, they will encounter key concepts from language, math, science and technology.

Research on the effect of using robotic-based products as an interdisciplinary teaching tool shows that students learn and understand concepts better when taught this way as opposed to more traditional means of instruction in a non-interdisciplinary set-up. Contact LEGO Dacta for more information about learning research.

Problem Solving Strategies and Skills

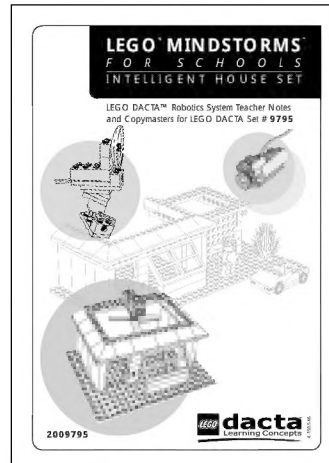
When students work on **ROBOLAB** projects, they also learn something about the very process of exploring and problem solving. In their individual learning, each student can become more familiar with the “art” of breaking down a problem into “mind-sized” parts, taking advantage of unexpected results of his or her own activity, repairing bugs and generating ideas and testing them.

Working in teams is an integral part of the activities in the Intelligent House. Students work in cooperation to accomplish the following:

- Reach a common goal.
- Communicate with each other.
- Plan, organize and execute a task within a deadline.
- Collect, analyze and organize information.
- Communicate ideas and information.
- Plan and organize resources.

Materials Overview

9795 Intelligent House Set



Activity Pack - 2009795

Project Set - 9795

The Intelligent House Set is a building set for a group of 2-3 students. Each set has over 150 pieces including:

- 1 light sensor
- 1 lamp
- 1 micromotor
- wires

Each set contains a Building Booklet, which includes introductory step-by-step instructions for each of the activities described in the student copymaster worksheets. The Intelligent House set is a very compact and efficient set for building. Once you build the main house frame, you can quickly build the programmable component for most activities in less than 15 minutes.

The activities in this binder build on your students' previous experiences with the **ROBOLAB** Starter Set 9780. If the Intelligent House set is their initial experience with **ROBOLAB**, see page 4 and <http://www.lego.com/dacta/robolab> for more information.



Materials Overview

Materials Needed

If you already have the **ROBOLAB** Starter System, the components you should have for adding the Intelligent House projects to your curriculum plans are as follows:

- 4 x 9795 - Intelligent House Set
- 1 x 2009795

The RCX bricks, IR Transmitters, and cables are not included in the Intelligent House set. You will already have them as part of your **ROBOLAB** Starter System. The **ROBOLAB** Starter System contains these components:

- 1x 9780 - **ROBOLAB** Starter Set
- 4 x 9709 - The LEGO RCX Programmable Brick
- 4 x 9713 - IR Transmitter and Cable (PC, Mac)
- 1 x 2009780 - Activity Pack
- 1 x 2000041 - Robotics Concept Guide
- 1 x (number varies) - **ROBOLAB** Software (see note below)
- 1 x 2000052 - Getting Started Teacher's Guide to **ROBOLAB** Software

Note: Software versions will vary. Those using **ROBOLAB** 2.0 and higher will have the Investigator software component that allows datalogging of sensor feedback. There are activities included in this pack which are written for use with both the Programmer (control) and Investigator (datalogging) software components.

If you do not have the **ROBOLAB** Starter System, your students may have experience with the **ROBOLAB** software from using the Amusement Park set (#9725) or the Team Challenge set (#9790). In both cases, they will have sufficient experience to move on with the activities in the Intelligent House set.

No Prior Experience with ROBOLAB Software

The ideal approach would be to purchase and work with the **ROBOLAB** Starter System; however, if that is not an option, you can purchase the software and the Teacher's Guide separately.

After installing the **ROBOLAB** software, follow the **ROBOLAB** video on the **ROBOLAB** CDROM to set up and test the hardware. Use the examples in the Getting Started Teacher's Guide for **ROBOLAB** Software to quickly introduce your student to the programming. Make students familiar with the 9795 **ROBOLAB** Intelligent House Building Booklet and adjust the schedule to allow students more time to build and program during the activities. It would be a good idea to focus on the Programmer Pilot level activities initially.

Scope and Sequence

KNOWLEDGE AND SKILLS	WHOLE CLASS	GETTING STARTED	INTERMEDIATE & ADVANCED	PROJECT
Designing and programming	x	x	x	x
Systems thinking				x
Design Technology	x	x		x
Problem solving challenges		x	x	x
Language				
Writing Style	x	x	x	x
Vocabulary	x	x	x	x
Grammar	x	x	x	x
Presentation Skills	x			x
Science				
Experimental methods			x	x
Collecting data			x	
Interpreting Skills			x	x
Temperature			x	
Light		x	x	x
Rotational position (angle)			x	
Mathematics				
Interpreting Graphs			x	
Measuring	x	x	x	x
Distance	x	x		x
Rotation (angle) (Requires extra purchase)			(x)	(x)
Temperature (Requires extra purchase)			(x)	(x)
Light		x	x	x
Percentage		x	x	x
Timing		x	x	x
Averaging			x	
Calculating		x	x	x



Classroom Management and Teaching Flow

The activities in the 9795 Activity Pack are structured around 2-3 students working with one building set. The activity pack provides a number of different learning opportunities for you and your class. There are several types of activities as described below.

Section 2 **WHOLE CLASS INTRODUCTORY ACTIVITIES**

- These activities introduce students to the overall theme of the projects.
- Use these activities as opportunities to involve all the students in a discussion on various types of homes, home design and the technological advances that can improve the enjoyment, comfort, safety and security in a home.

Section 3 **GETTING STARTED ACTIVITIES USING PILOT**

- These activities are a series of worksheets with structured lessons and problem solving activities for students with accompanying teacher notes. The activities in these three sections are specific to the Building Booklet. These activities will familiarize students with the step-by-step models in the set and refresh their prior knowledge of the RCX and the **ROBOLAB** software.

Section 4 **INTERMEDIATE AND ADVANCED IDEAS USING INVENTOR**

- These activities continue the worksheet and teacher note format as used in the Getting Started activities but extend the programming into higher levels of the ROBOLAB Programmer component.

Section 5 **INTERMEDIATE AND ADVANCED IDEAS USING INVESTIGATOR**

- These activities continue the worksheet and teacher note format as used in the Getting Started activities but extend the programming into higher levels of the **ROBOLAB** Investigator component (requires **ROBOLAB** 2.0 or higher). Investigator allows users to capture data from sensors and then analyze it so these activities focus more on science ideas.

Note: The angle sensor and temperature sensor activities require an extra purchase.

Section 6 **PROJECT: HOME OF THE FUTURE**

- This is an extensive project for in-depth, cooperative learning work that can extend to 10 or more class lessons. They cover a number of subject areas and allow students to explore more difficult challenges.
- The projects consists of an overview with objectives; a getting ready section which outlines what is need and the teaching flow; an explanation of the activities within the project; student handouts for specific activities; and possible extension ideas.

Assessment Ideas

For ongoing student assessment, many teachers use a variety of methods, including:

- ☐ Observations of students at work
- ☐ Student journals
- ☐ Note taking
- ☐ Task checklists
- ☐ Student presentations
- ☐ Conversations with students
- ☐ Noting question students ask
- ☐ Student portfolios

A portfolio of completed worksheets, job sheets and printed copies of **ROBOLAB** programs show how the level of student performance and understanding improve over time. In addition you can ask each student to keep a journal. Frequent writing not only enhances written communication skills, it also encourages a means of improving the discussion in the classroom. Students tend to be more prepared for discussion and problem solving after having written about a topic. Writing promotes thinking and thinking is exactly what we want. Some suggestions for self-assessment questions include:

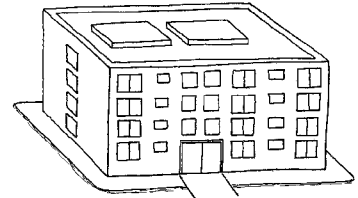
- ☐ What did I learn?
- ☐ How well did I learn it?
- ☐ How much did I enjoy it?
- ☐ What will I do next?
- ☐ How could I apply this in everyday life?

What's in a House?

Learning Objectives

Students will:

- ☐ Discuss and brainstorm general points about the places that we live and how climate, geography and technology affect where and how we live.
- ☐ Communicate ideas and information to the rest of the class.



Materials

- ☐ Writing materials to record information for the group, e.g., whiteboard and markers, blackboard and chalk or flipchart.

Here's What To Do

CLASS BRAINSTORMING

Discuss with students the important aspects of shelter.
Consider these aspects.

- 1 ☐ Describe geography of where you live.
 - ☐ Do you have a variety of weather?
 - ☐ What is the temperature range throughout the year?
 - ☐ Do you live in an area that has need of any special monitoring equipment for potential disasters such as tornado, hurricane, earthquake, monsoon, tsunami?
- 2 ☐ Consider what sort of shelter you live in.
 - ☐ From what materials is it constructed?
 - ☐ Are these materials found near where you live or are they brought from far away?
- 3 ☐ List what types of technology are included in your homes today.
 - ☐ Heating and cooling systems for physical comfort
 - ☐ Television, CD players, computers, game systems for entertainment
 - ☐ Smoke alarms, fire alarms, carbon monoxide alarms,
- 4 ☐ Consider what technology is available now that was not available 100 years ago.
- 5 ☐ Imagine what your day would be like without the technology you use for comfort, safety, health, and fun?
- 6 ☐ Brainstorm what new technologies you would invent to make your lives better in the future.

Please note: To use the Journal feature suggested on the student copymaster for this activity, you must have **ROBOLAB 2.0** or higher and you must have installed the Investigator component. The Investigator button appears on the introductory **ROBOLAB** screen.

Home Floor Plan

Learning Objectives

Students will:

- Create a map of their homes.
- Use mapping skills to visualize and analyze a situation.
- Communicate ideas and information to the rest of the class.

Materials

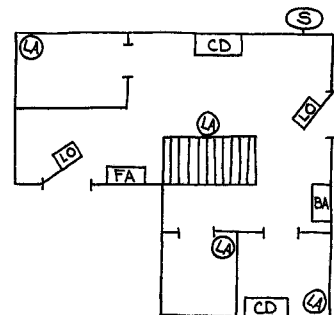
- Photocopy of the Home Floor Plan sheet for each student.
- Pencils of different colors (erasable writing utensils will save a lot of frustration!)

Here's What To Do

- A floor plan shows the layout of rooms in a building. Have each student make a floor plan of his or her home to share with the class. You can either choose to do this with a specific scale in mind and have each student go home and measure. Or, you can do it very loosely and ask each student to just make a rough floor plan from memory.
- A copymaster for the activity follows these notes. A scale is not specified. If you want students to make scaled drawings, you may wish to have them round the measurements to the nearest half a metre/meter or half of a foot.
- As part of the floor plan, students are asked to mark the lighting and other appliances and systems that make the home comfortable, safe and pleasant. You may wish to just have them choose 2 or 3 rooms to mark with the appliances. Some students may wish to draw small objects to indicate the appliances and systems. Others may prefer just to mark a letter or number and then have a key for their floor plan to show what it is; for example, "L" is Lamp, "FA" is fire alarm, "CD" is CD player.
- Have the students bring their floor plans to back to school. Lay the floor plans out on a large table or on the floor of the classroom as if they were in a large neighborhood.
- Walk around the neighborhood and ask each student to describe his or her home.
 - What is their favorite area of their home?
 - Where are they most comfortable?
 - What technology helps them feel comfortable and enjoy themselves at home?
 - What would they like to add or take away from their home to make it better?
- Now ask students to look back at the brainstorming work that they did previously.

Have each one choose two or three new features from the brainstorming session to add to his or her home floor plan. Then ask each to write a paragraph or two that describes what it is like to live in the new "dream home".

Note: This is also a good activity to do using a computer drawing program.

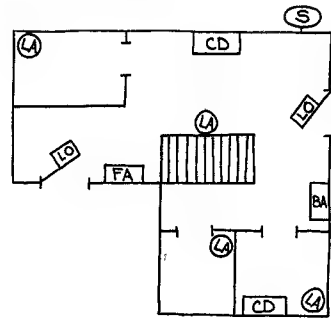


KEY

LA = Lamp
CD = CD player
FA = Fire alarm
S = Satellite dish
BA = Burglar alarm
LO = Lock

Home Floor Plan

You are going to create a type of "map" of your home. This is called a floor plan.



KEY

LA = Lamp
CD = CD player
FA = Fire alarm
S = Satellite dish
BA = Burglar alarm
LO = Lock

- Using the Home Floor Plan graph paper sheet, draw a floor plan type map of your home. Use simple straight lines to show where the walls are outside and inside your home. Leave spaces to show where the doors are.

- Mark lighting, communication, security, entertainment, heating and cooling systems and other comfort and security-related aspects in 2-3 of the rooms in your home. You can either draw these as little shapes or use a letter or number. Remember to create a Key for the codes that you use so others can understand how to read the floor plan.

- Brainstorm some new ideas to add to your home.

- Add 2-3 of your new ideas to the design on your Home Floor Plan sheet.

- Now, on this sheet or perhaps in the Journal section of the Investigator software describe life in your home with your new things added. What is a day like? How do you spend your time?

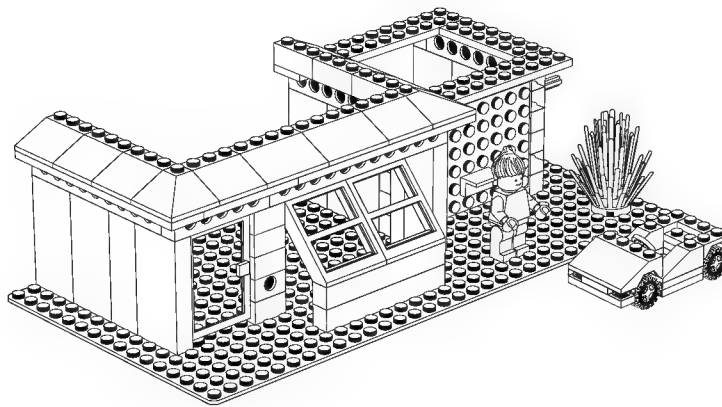
Home Floor Plan Graph Paper

Use this graph paper to draw a floor plan of your home.

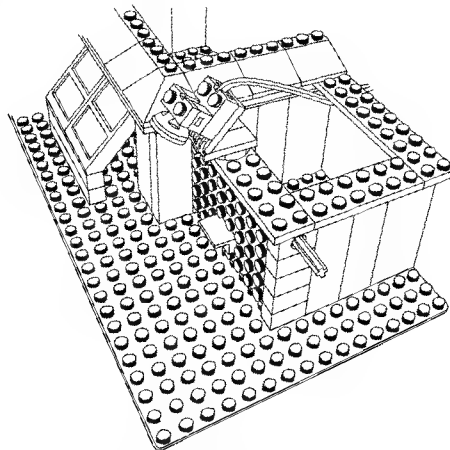


The House and the Lamp

You are going to build the main structure of the house and program the outdoor lamp to turn on and off.



- 1 ○ Build the intelligent house as shown in the Building Booklet pages 3-7.
- 2 ○ Add the outdoor lamp as shown on page 8. Be sure to attach the lamp to output port A.



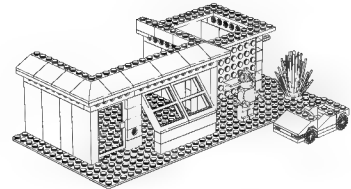
- 3 ○ Load the **ROBOLAB** software. Select Pilot 1.
- 4 ○ Using Pilot 1, program the outdoor lamp to turn on and off. Choose the length of time from the available icons.

The House and the Lamp

Learning Objectives

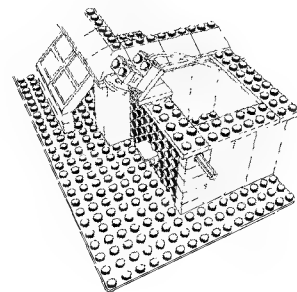
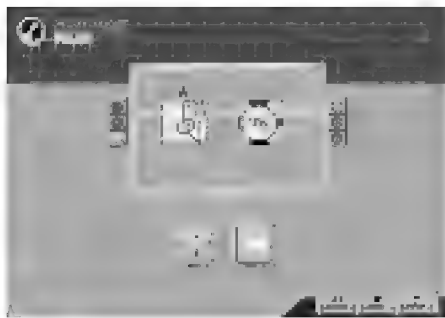
Students will:

- Review how to program the RCX using output device such as the lamp.
- Reacquaint themselves with **ROBOLAB** Pilot programming.
- Build the main walls of an Intelligent House that can be used throughout the project.



Discussion

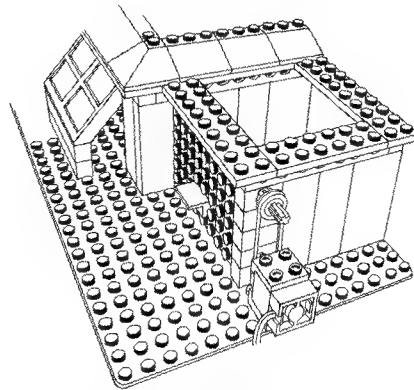
The programs will not stop automatically after the lamp turns off. Students must press the Run button on the RCX again to stop their Pilot 1 programs.



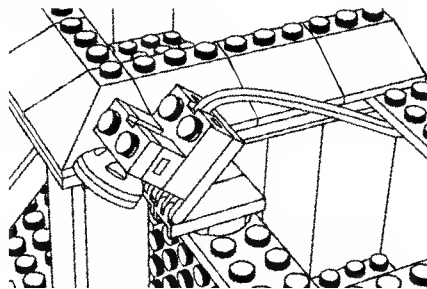
This Pilot 1 program turns on the lamp in port A and then turns it off after 10 seconds.

The Lamp and the Garage Door

You are going to program the garage door to open and close.



Keep the outdoor lamp attached also.



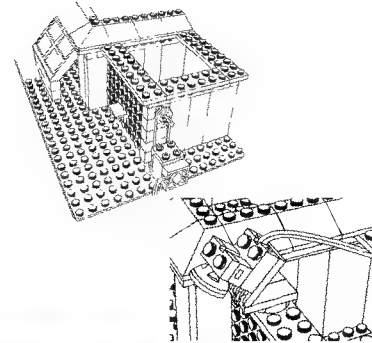
- 1 ☐ Add the motorized garage door as shown in Building Booklet on page 9. Attach the lamp to port C and the motor to port A.
- 2 ☐ Load the **ROBOLAB** software and choose Pilot 2.
- 3 ☐ Create a Pilot 2 program to open the garage door.
- 4 ☐ Then download it and test it.
- 5 ☐ Make any corrections and test again.
- 6 ☐ Now create a program to close the garage door.
- 7 ☐ Then download it to a different Program slot.
- 8 ☐ Make any corrections and test it again.
- 9 ☐ Now you have a working garage door with an open and close button control.

The Lamp and the Garage Door

Learning Objectives

Students will:

- Review how to program the RCX using output devices such as the lamp and micromotor.
- Reacquaint themselves with **ROBOLAB** Pilot programming.



Discussion

Pilot 2 allows users to control two outputs but has only one step. Therefore, students must create separate Open and Close programs and download the programs to separate Program slots on the RCX.



open



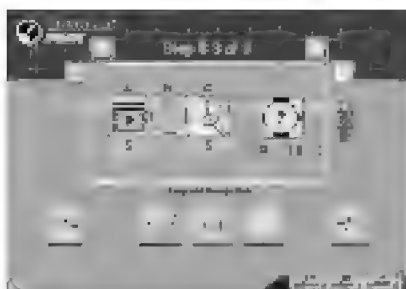
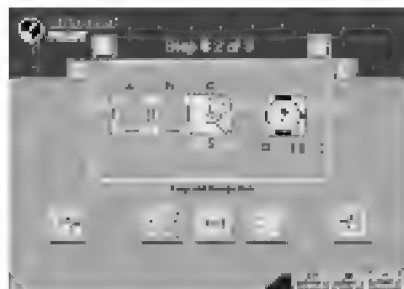
close

If students change the power level, the amount of time needed to open or close the garage may change.

If students are comfortable with programming or have experience using Pilot 4, they can combine the open and close functions. Here is a three-step Pilot 4 program that adds a one-second pause in between the opening and closing of the garage door.

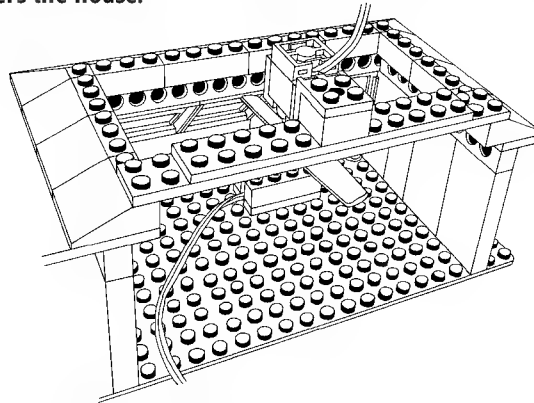


open



The Ceiling Fan

You are going to create a ceiling fan that starts when someone enters the house.



- 1 Build the ceiling fan as shown on pages 15 to 17 of the Building Booklet.
- 2 Make sure you attach the light sensor to port 1. Attach the motor for the fan to output port C.
- 3 Load the **ROBOLAB** software and choose Pilot 3. Create the light sensor view program and download it.
- 4 Next, press the View button of the RCX to see what the light value (displayed in a percentage) is when the light sensor is on and shining toward the wall of the house. (Make sure the little carat sign is pointed toward input port 1.) Write that number here.

- 5 Next, block the light sensor beam with the LEGO figure, your finger or some other object (whatever you are planning to use when the program is running.) Check the light sensor value now. Then write down the value of the light sensor.

- 6 There are two steps to a Pilot 3 program. Program the motor for the ceiling fan to start when someone enters the house.
- 7 Download and test the program using the Single Run feature (default).

If the program does not work, check that your motor and sensor are attached correctly. Also, check that the light sensor values in your program are within the correct range.
- 8 Next, change the download option to Continuous Run. Make sure the double arrow is showing. Then download the program again and run it.

If necessary, adjust your program so the ceiling fan can be set to run for a few seconds whenever someone enters the room.

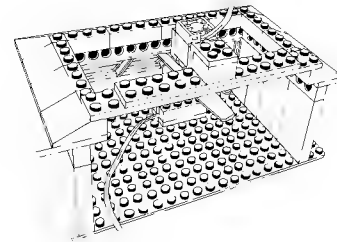


The Ceiling Fan

Learning Objectives

Students will:

- ☐ Build a motorized fan and program it to run using Pilot 3 or higher.
- ☐ Program a machine to respond to feedback from a light sensor.
- ☐ Write a program that runs continuously.



Discussion

In order to see the light sensor values in percentages on the RCX View Display, users must download a program such as the one shown on the student copymaster page that includes a light sensor on the correct port. Otherwise the values in the View display are shown in raw form - as numbers between 0 and 1023. ROBOLAB light sensor icon commands expect percentages as input.

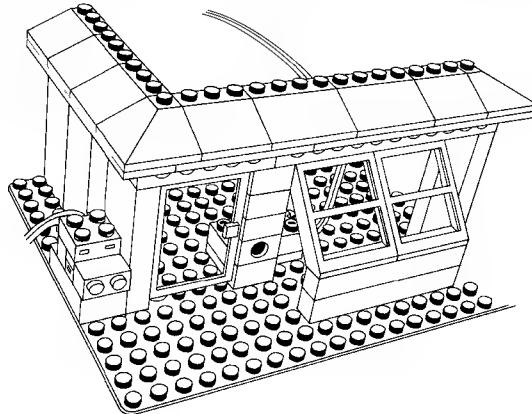
Here is an example of a program that controls turns on the ceiling fan when someone enters the room and passes by the light sensor. Notice that Pilot 3 allows users to program using two steps. In the example program, all outputs are on Stop waiting for the light sensor to see dark. In the second step, the motor in port C is set to the left (or right, it doesn't matter). It can be set to any level. Level 3 is shown here. The fan motor stays on for 6 seconds then turns off and the program starts over.



If students want to do a more elaborate program, suggest that they try using Pilot 4 or Inventor.

The Burglar Alarm

You are going to create a burglar alarm system using the light sensor and a lamp. Then add a motorized device to scare intruders!



Use micromotor pieces for your scarecrow.

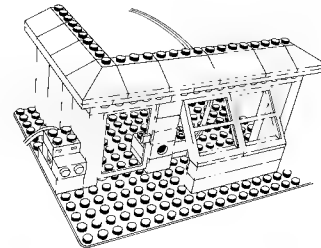
- 1 Build the burglar alarm as shown in the Building Booklet on page 11. Make sure the lamp is attached to port A and the light sensor is attached to input port 1.
- 2 Load **ROBOLAB** software and select Pilot 4.
- 3 Program the burglar alarm to activate when someone passes by the light sensor.
- 4 Download and test your program.
- 5 If the program doesn't work, use the View feature of the RCX to check that the light sensor readings you chose for the program are within a usable range.
- 6 The lamp turning on didn't surprise the burglar! Program the lamp to flash as a warning!
- 7 Download your revised program and try it.
- 8 Now, you really want to make sure an intruder gets the message. Create a motorized device to scare anyone who enters! The lamp and motor can turn on at the same time.

The Burglar Alarm

Learning Objectives

Students will:

- Build a working alarm system for the house using light sensor feedback.
- Program the alarm system to work using Pilot 4 (or higher).
- Create a motorized device to scare intruders!
- Program multiple output devices to respond to one input.



Discussion

In the Ceiling Fan Activity 3, you will find an example program for checking the light sensor values using the RCX View Display.

Here is an example of a four-step Pilot 4 program that waits for the light sensor to be activated (input is less than 50 — students need to use their own number here). Then it flashes the lamp on and off and back on. The program is set for Continuous Run so the first step of the program running again is to turn off the lamp.

Students can flash the lamp on and off more times by adding more steps. They can also adjust the power level of the lamp.



Use micromotor pieces for your scarecrow.



1



2



3



4

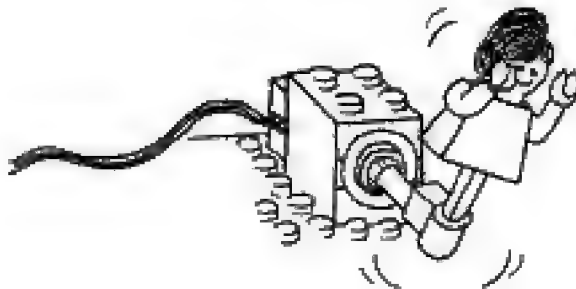
Teacher Notes for use with Set 9795

SECTION 3

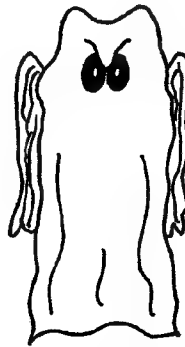
**GETTING STARTED
ACTIVITIES**

The Burglar Alarm

Here is a motorized 'scarecrow' to frighten intruders.



Students can draw their own scary creatures and attach them to the motorized axle with tape or other material. Here are a couple of scary creature ideas. After photocopying, students can cut them out and use them as is or as a size guide for their own design.



Students should scale their drawings or "scarecrow" objects to about 2.0 - 3.0cm wide and 3.5 - 5.0cm high.

Teacher Notes for use with Set 9795

**SECTION 3 GETTING STARTED
ACTIVITIES**

The Burglar Alarm

To control the lamp and motor at the same time, use Pilot 4. Here is a 4-step example program.



1



2



3

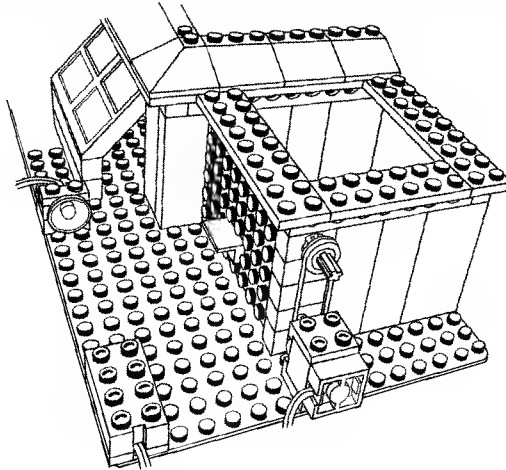


4

For further ideas using the Inventor style of programming, see The Burglar Alarm 2 activity in Section 4.

The Automatic Garage Door

You will use a light sensor and a lamp to create an "electric eye" that can be used to control a motorized garage door.



- 1 ○ Arrange the lamp, light sensor and garage door motor as shown on page 10 of the Building Booklet.
- 2 ○ Attach the motor to port A, the lamp to port C and the light sensor to port 1.
- 3 ○ Create a program that waits for the light sensor to be activated before opening and closing the garage.

Note: Turning on the lamp across from the light sensor creates an "electric eye" beam which is a more reliable than depending on the ambient light around the light sensor.

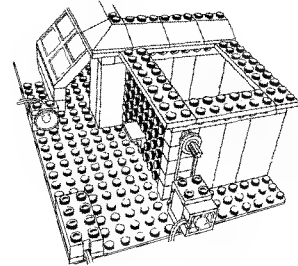
- 4 ○ Click the plus sign to add steps. Click the minus sign to delete the step showing on the screen.
- 5 ○ Test your program by driving the car into the garage. Make sure the door opens and stays open until the car is parked inside. Does it work? Ask a classmate to try it!

The Automatic Garage Door

Learning Objectives

Students will:

- Create an "electric eye" using the light sensor and a lamp that can be used to activate the garage motor.
- Write a program that runs continuously.



Discussion

The solution shown here is set for Continuous Run. The program includes a step in the beginning that turns on Lamp C (across from the light sensor) for half a second. This prevents the light sensor from being triggered at the start of the program and starting the garage motor too soon.

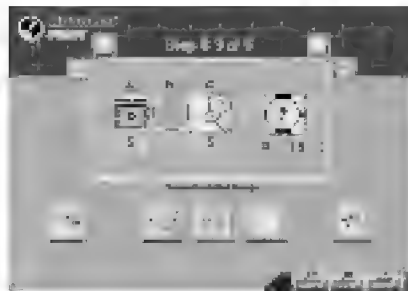
Note: Since the program is set for Continuous Run, users must press Run to stop the program.



1



2



3



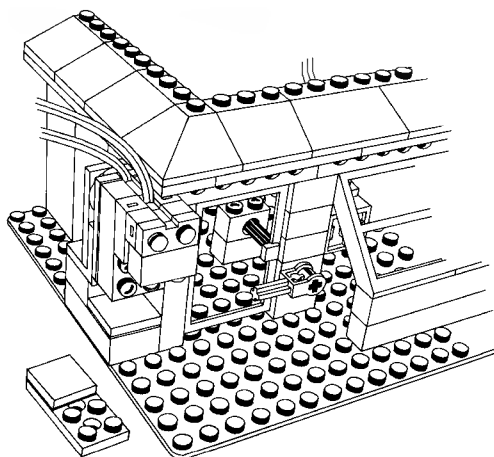
4



5

The Door Lock System

You are going to build a key card system to control the lock on the front door.



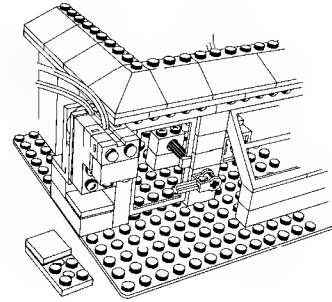
- 1 ○ Build the door lock system as shown on pages 27-32 in the building booklet.
- 2 ○ Make sure the light sensor is attached to port 2, the lamp is attached to port A and the motor to port B.
- 3 ○ Load **ROBOLAB** and select Pilot 3.
- 4 ○ Using the View feature of the RCX, find the light sensor value range for each of the LEGO tile "key cards" built for the door lock system. To do that, create a Pilot test program that activates the light sensor in port 2.
- 5 ○ Download the test program and run it.
- 6 ○ On the RCX, select View for port 2. Place each of the LEGO key cards in front of the light sensor and record the values. Write the light sensor values here.
 White _____
 Red _____
 Blue _____
 Grey _____
- 7 ○ Go back to the Pilot menu and select Pilot 4.
- 8 ○ Now use the keycard information you collected above and create a program that allows only one key card to unlock the door.
- 9 ○ Download and test the program.
- 10 ○ Set the program for Continuous Run and test it again.
- 11 ○ Can one of your friends get in without the right key?

The Door Lock System

Learning Objectives

Students will:

- Find the range of light values for several colors.
- Create a program that uses the light value data to control the locking and unlocking of the door motor.



Discussion

Students can modify the LightView program from the Ceiling Fan activity to find the light sensor values. The most important change is to make sure the light sensor is placed in port 2 in the program. Pilot 3 is a useful level for this test program because in Pilot 4 the additional steps can cause a "flicker" in the lamp.

The door lock solution shown here uses a four-step Pilot 4 program. Step 1 turns on the lamp that stays on throughout. The program waits for the light sensor to see the white key that generally has a value over 59%. When the light sensor sees the white key in the door lock system, the motor turns to open the locked door. In steps 3 and 4, the motor pauses, then reverses direction to lock the door again. The program is set for Continuous Run.



1



2



3

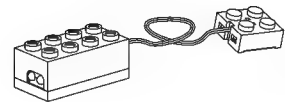
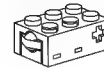
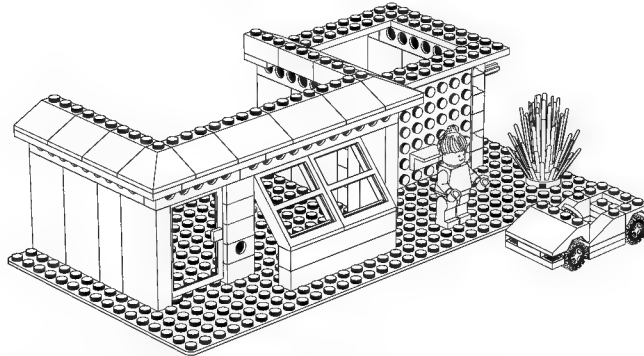


4

Using Pilot, you can only wait for the upper or lower key color range so you can't usually use grey or red for the key. You can program red or grey as the key if you use Inventor programming. See the Door Lock 2 activity in Section 4: Intermediate and Advanced Ideas Using Inventor for more information.

The Doorbell

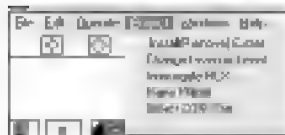
You are going to program a doorbell to sound using a light sensor and a ROBOLAB Beep. Then you can create a musical doorbell using the Piano Player Extras in ROBOLAB. If you have a touch sensor, you can program a "push button" doorbell also.



- 1 Attach a light sensor to the house model. This works best if you place the light sensor facing one of the white walls. That way, you will have a very reliable reflection from the red light from light sensor back to the receiver inside the light sensor. Make sure you leave enough room for the LEGO figure (or your fingers) to activate the light sensor. Attach the sensor you are using to port 1.
- 2 Load the **ROBOLAB** software and select Inventor 2.
- 3 Create an Inventor program that waits for the light sensor to see "dark" (less than 55%). After the light sensor is activated, sound one or more Beeps. Add the Land and Jump icons   to make the program run continuously.

Note: If you have a touch sensor, you can use that instead of a light sensor.

- 4 Download and test the program. You may need to add a Wait For icon after the Beep(s) so that the program doesn't cycle too fast. (It gives more time for your fingers to move out of the way!)
- 5 Your basic doorbell works. Next try to create a more musical one using the Piano Player. To do that, first select Change Inventor level from the Project menu. Then select Inventor 4 from the next menu that appears.
- 6 Now select Piano Player from the Project menu. (If you don't see it in the menu, check that your teacher has installed the Extras on your computer.)



- 7 You can "record" musical phrases on the Piano Player by clicking the pointer on the piano keys. Then save the series of notes to the red, blue or yellow scroll. The scrolls  are icons that you can select from the Inventor 4 Music menu.

Copymaster for use with 9795

SECTION 4

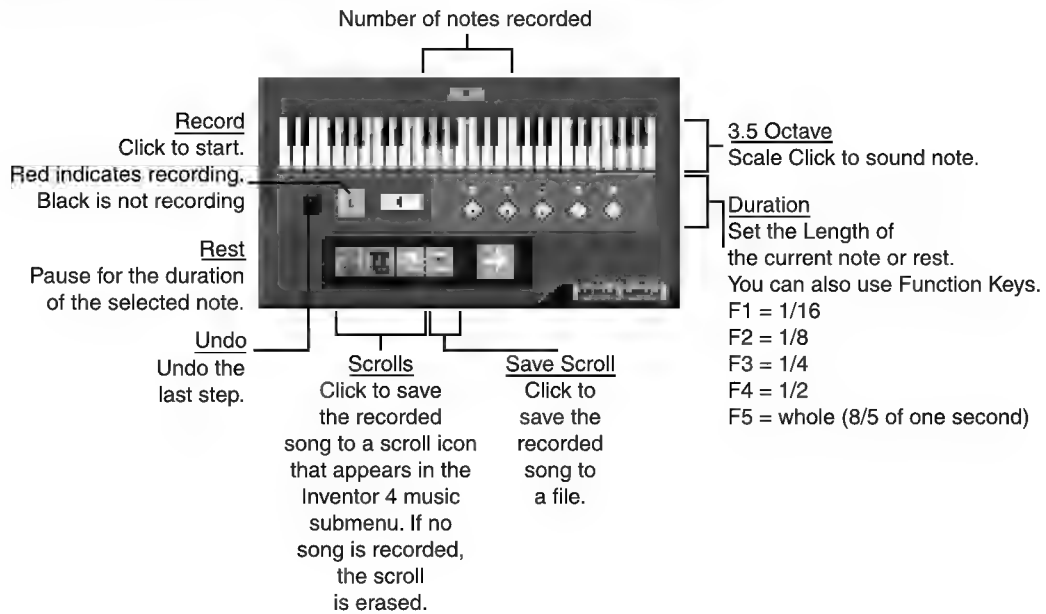
**INTERMEDIATE AND
ADVANCED IDEAS USING
PROGRAMMER INVENTOR**

ACTIVITY

1

- 8 Here is a summary of the Piano Player features.

Note: To use the Piano Player, make sure the RCX is turned on and communicating with the IR Transmitter.



- 9 Now change your program to sound the music you recorded on the scroll instead of the Beeps.
- 10 Download the program and try your new doorbell.

Teacher Notes for use with Set 9795

SECTION 4

INTERMEDIATE AND ADVANCED IDEAS USING PROGRAMMER INVENTOR

ACTIVITY

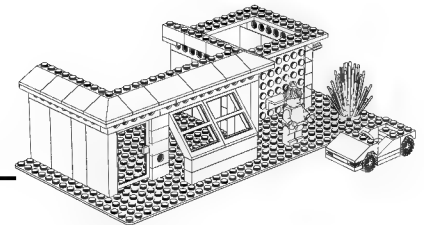
1

The Doorbell

Learning Objectives

Students will:

- Write a program to react to a light sensor or touch sensor.
- Add music to their program using the Piano Player from the ROBOLAB Extras.



Discussion

Use the sound functions in Inventor, the Beep, and Piano Player to create a doorbell that sounds when a light or touch sensor is activated. The light and touch sensor programs are very similar. Students can add more than one Beep if they wish.



05



15

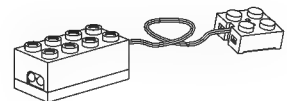
In versions of **ROBOLAB** prior to 2.5, the Piano Player must be installed separately. To install it, go to Programmer/Inventor or Investigator. Select Install (Remove) Extras from the Project menu. Follow the directions on the screen. You will have to reboot ROBOLAB to see the changes in the Project menu and Inventor 4 levels.

In order to hear the Piano Player sounds made on the RCX, the RCX must be communicating with the computer through the IR Transmitter.

Here is a version of the doorbell program with the Scroll icon instead of the Beep icon.

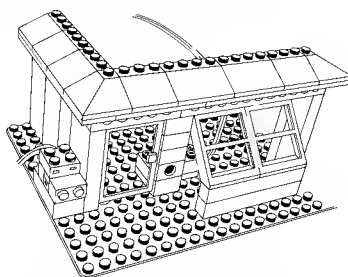


05



The Burglar Alarm 2

You are going to create a burglar alarm that uses sound, light and a motorized "scarecrow" to scare away a burglar.



Use micromotor pieces for your scarecrow.

- 1 Add the light sensor to the house as shown on page 11 of the Building Booklet.
- 2 Make sure the lamp is connected to port A and the light sensor is connected to port 1.
- 3 Load the **ROBOLAB** software and choose Inventor 3.
- 4 Create a program that turns on the light and makes some sounds when the light sensor is activated. Also add the movement of the motorized scarecrow you created in the first Burglar Alarm activity. You can use the Jump and Land icons to make the program run continuously.

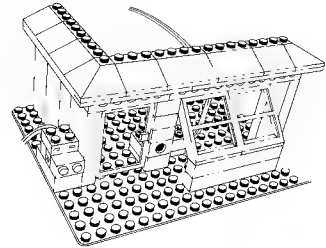
- 5 Download the program and run it.
- 6 Try to sneak the LEGO figure through the door past the light sensor. Does your burglar alarm work? If not, check the light sensor reading as the LEGO figure is in front of the light sensor and compare it to the light sensor setting in your program.
- 7 For a more dramatic burglar alarm, use the Loop icons  to make the sound and lamp turn on more than once. Create a loop that runs inside the Jump and Land structure.
- 8 Download the program with the loop and try it.
- 9 What do you think? Is it a better burglar alarm? The Loop runs twice as a default but you can modify the command to run many more times.
- 10 Finally, use the Piano Player to create a more elaborate sound for your burglar alarm. (See a description in the Doorbell activity). Change to Inventor 4. Then choose Piano Player from the Project menu so you can record a scroll of your own!

The Burglar Alarm 2

Learning Objectives

Students will:

- Use Inventor Level programming.
- Create a program that Loops inside another type of looping structure.
- Combine multiple outputs responding to one input.
- Use the Piano Player from the **ROBOLAB** Extras.



Discussion

The burglar alarm can involve sound and light to make it more effective. The motorized scarecrow the students created in the Burglar Alarm activity is included for fun, too. Here is an Inventor Level 3 program that involves a Loop inside the Jump and Land structure. Notice that the motorized movement is outside the Loop. That way, the scarecrow pops up and stays there while the lamp and sound turn on and off multiple times (5 times in this example).



The Piano Player function allows students to easily add more complex sounds to their programs. See the Doorbell activity for an explanation. Here is an example of a program that substitutes a Scroll icon with a musical sequence recorded on it. The Scroll replaces the Beep.

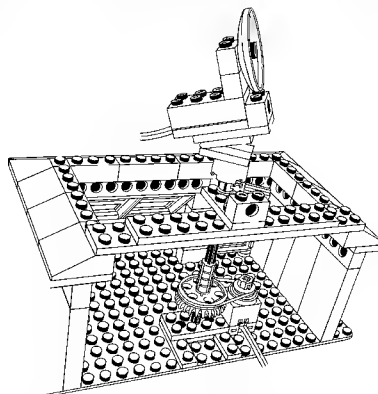


If students don't record their own songs, the default song will play (unless it was erased). The default songs are as follows:

Red Scroll	Frere Jacques
Blue Scroll	Row, Row, Row Your Boat
Yellow Scroll	Twinkle, Twinkle Little Star

The Satellite System

You are going to program a motorized satellite dish using a light sensor to find the best signal. The satellite dish moves back and forth, scanning the sky for the best signal. A handheld LEGO lamp serves as the "satellite" in space sending signals to Earth.



In reality, satellites do not use light to communicate. Instead microwave signals are sent over short distances or relayed from a satellite to almost anywhere in the world. Satellites travel at the same speed as the Earth rotates. They orbit 22,300 miles above the Earth and can relay information from any part of the world to any other part. Telephone conversation and television signals travel this way.

- 1 Build the satellite system as shown on pages 18-20 of the Building Booklet. Check that you attach the light sensor to port 1, the lamp to port A and the motor to port C.
- 2 Load **ROBOLAB** and select Inventor 4.
- 3 The light sensor can see light from the lamp. However, the distance of the lamp from the light sensor and direction the lamp is facing affects the amount seen. Therefore, you should find out an appropriate light value to use as your "signal".
- 4 Use the View feature of the RCX display to find the right value. Remember to hold the "satellite" lamp at a useful distance in front of the light sensor "satellite dish" before recording the light value shown on the display.

Record the value range here. This will be the "signal" that your program seeks.
- 5 Now program the satellite dish to scan the sky for the proper signal. When the satellite dish sees the signal, it should stop. When the satellite dish loses the signal, it should start again.
- 6 You can use the Light Sensor Fork and Jump and Land icons to set up a loop that checks the light sensor.



Or, you can use the Loop While icons from the Loop submenu under Structures. You can choose either Loop While Sensor is Greater Than or Loop While Light Sensor is Less Than.

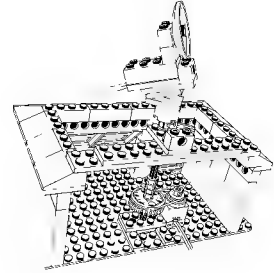


The Satellite System

Learning Objectives

Students will:

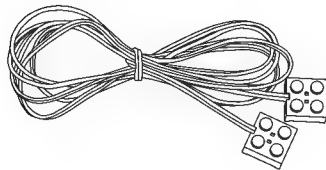
- Use Inventor Level 4.
- Program a system to monitor light and use it as feedback to a motor output.
- Simulate a satellite system.



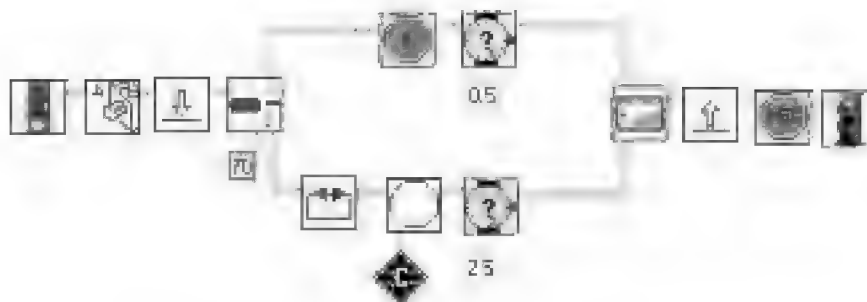
Discussion

If students are not seeing percentage values on the RCX display, they will have to create a program in ROBOLAB that uses the light sensor in port 1 and download it.

Students can attach wires to each other to lengthen the connection to the RCX from a sensor, motor or lamp. It is especially useful when they are working with the light sensor on the satellite dish.



You can use the Light Sensor Fork to check the light sensor value periodically. In the example shown below, if the light sensor sees more than 70% light, the motorized satellite dish stops. Otherwise, it continues scanning back and forth. The Flip Direction, Turn Outputs On and Wait For 2.5 Seconds commands control the scanning movement.

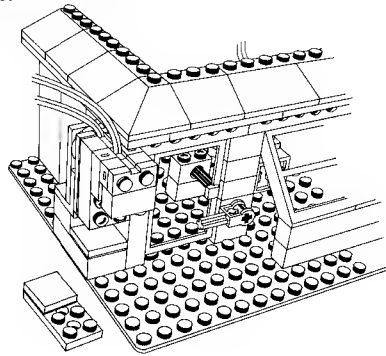


You can also use the Loop While structures. Here is an example of a program that uses the Loop While Light Sensor is Less Than. This program can react more quickly when the light level moves above or below 70%.



The Door Lock System 2

You can make your Door Lock System from the first Door Lock System activity more secure.



- 1 ○ Set up the door lock system as shown on pages 12-14 in the Building Booklet.
- 2 ○ Make sure the lamp is attached to port A, the motor is attached to port B and the light sensor is attached to port 2.
- 3 ○ Load the **ROBOLAB** software. Select Inventor Level 4.
- 4 ○ The Light Sensor Fork icon  compares the current light level input by the sensor to a set value. The default value is 55. If the current light level is above that value, one task is run. If the light level is equal or below that value, a different task is run.
- 5 ○ Create a program using Light Sensor Forks to check for the range above and below the grey, red or white key card. To start, check all the light sensor values using the View in the RCX display.

 White _____
 Red _____
 Blue _____
 Grey _____
- 6 ○ Using the light sensor ranges above, decide which key you want to use to unlock the door. Then create your program.
- 7 ○ Download and test it by trying all the keys in the lock. Is there only one that opens the door? If not, revise the program to use a narrower range of values.

The Door Lock System 2

Learning Objectives

Students will:

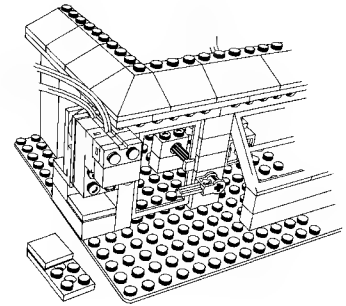
- Use Inventor Level 4.
- Create a program to recognize a specific color.

Discussion

Expanding on the concepts learned in the Door Lock System 1 activity, students can create a more sophisticated program that checks for a specific color key.

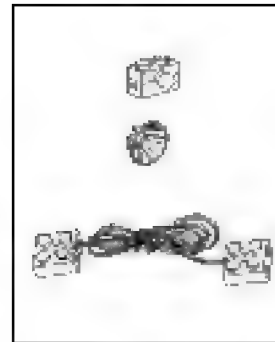
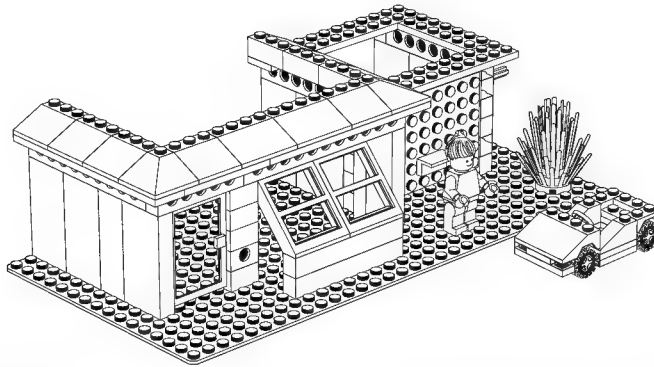
To do this, they can use two Light Sensor Forks to trap for a small range of light values. The program shown here checks for the grey color key in the middle range of light values (between 51% to 53%).

The Jump and Land icons make the program run continuously.



The Automatic Lamp

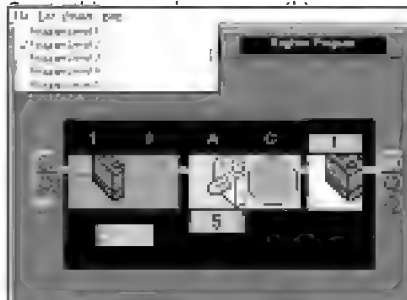
You are going to program a lamp to turn on at night and turn off in the morning. Using the Investigator software, you can track the light data, view the results, and write a description of what happened.



- 1 Attach the light sensor to the house model so that the sensor can see the light in the room. Add a lamp inside or outside the house — where you think a light sensor-controlled lamp would be the most useful.
- 2 Make sure the light sensor is attached to port 1 and the lamp is attached to port A.
- 3 Load the **ROBOLAB** software. Select Investigator.
- 4 Click on New Project to create a new project file with your own file name.



- 5 Select Program Level 2. Program Level 2 (a) is a Pilot type of programming.



(a)



(b)

Using this level, you can set the RCX to capture or log data from two sensors and to program two outputs. The outputs stop after an event occurs. This program captures or logs the data from the light sensor and turns off the lamp when the light sensor sees a brighter light.

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SECTION 5

**INTERMEDIATE AND ADVANCED
IDEAS USING INVESTIGATOR
PILOT AND INVENTOR**

The Automatic Lamp

- 6 Download the program and run it. Move the light sensor so it sees more light or shine a light into it. This stops the program and the datalogging.

- 7 Click the Upload icon to select the Upload template.



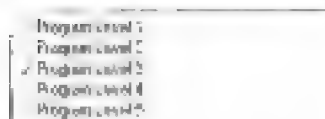
- 8 Upload the data by clicking the Upload arrow.



- 9 You can change the data to a differently colored bin if you like. Make sure the bin is labelled correctly. It should be called Light % or something similar. You can change the name of your page in the right hand corner.



- 10 Now you are ready to create a control program that runs continuously. This program should turn on the lamp when the room is darker and turn off the lamp when the room becomes lighter. Change to Program Level 3.



This level allows you to log sensors and create control programs with 3 steps.

Copymaster for use with 9795

SECTION 5

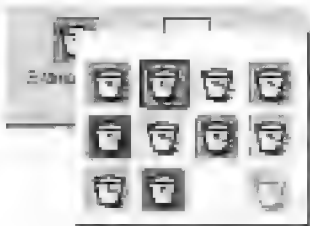
**INTERMEDIATE AND ADVANCED
IDEAS USING INVESTIGATOR
PILOT AND INVENTOR**

- 11 After creating your program, download it and run it. Slowly darken the light level (usually just slowly putting your hand in front of the light sensor works) and pause after the lamp turns on. Wait a bit. Then slowly move your hand away.

- 12 Go to the Upload page. Click the Plus sign to add a page.



- 13 Upload your data. Select a bin color and name the bin for the data.



- 14 Click on View to see all the data. Select the latest data bin to view just that information.



- 15 Go to the Journal page. Select Describe Page.



- 16 Select the View page for the bottom part of the Describe Page template.



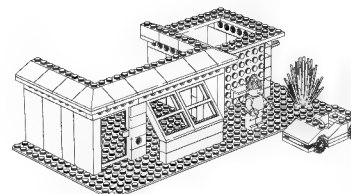
- 17 Write a description of what happened when the light sensor values changed.

The Automatic Lamp

Learning Objectives

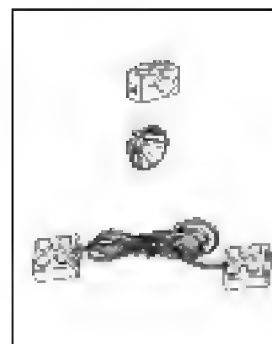
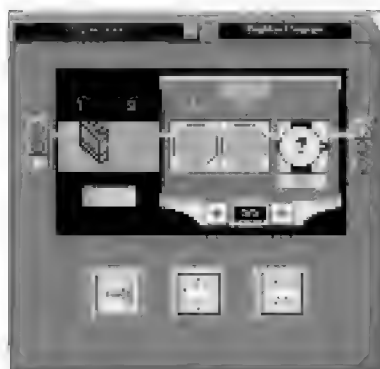
Students will:

- Write a program to make an input control an output using Pilot Levels 2 and 3.
- Also in the program, capture data from a light sensor over time.
- Graph the light sensor data.
- Write a report about their project, describing the results.



Discussion

It is a nice idea to use the View option on the RCX display as students are running their programs. That way, they can relate the values they see on the RCX with the graph values, e.g., the lamp turns on at 51%. Here is an example program.



Teacher Notes for use with Set 9795

SECTION 5

**INTERMEDIATE AND ADVANCED
IDEAS USING INVESTIGATOR
PILOT AND INVENTOR**

Students must remember to click the Plus sign to add pages when they want to upload new data.



On the View page, students can view bins separately or all together.

Students can use the Investigator Journal to write about the project. This is an example of the Describe page template showing the View page with light sensor data. Using other Journal templates, students can add JPEG images (such as a photograph of their model) or simply write a text description of some aspect of the project.



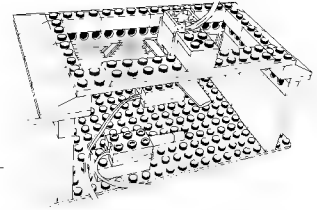
Students can also Publish their projects as web pages or as on-screen presentations. Click the Publish button.



For more information about the Investigator software, see the book *Getting Started 2: Teacher's Guide for ROBOLAB 2.0 Software*.

The Ceiling Fan and Temperature Sensor

You are going to create a system to track the use of the ceiling fan. The ceiling fan turns on when the temperature rises above a certain level. Using the Investigator software, you can track the temperature data, view the results, and write a description of what happened.



- 1 Add the temperature sensor to the house model as shown on page 24 of the Building Booklet.
- 2 Make sure you attach the temperature sensor to port 3 and the ceiling fan motor to port C.
- 3 Load the **ROBOLAB** software. Select Investigator.
- 4 Click on New Project to create a new project file with your own file name.
- 5 Select Program Level 3.



Using this level, you can set the RCX to capture or log data from two sensors and to create a three-step program.

Create a program that captures or logs the data from the temperature sensor. The program should also turn on the ceiling fan when the temperature reaches a certain level and turn off the fan when the temperature drops below a certain temperature.

Notes:

You can choose to measure in degrees Celsius or degrees Fahrenheit.

You don't actually need the light sensor but using the Investigator Pilot levels you have to have something attached to port 1.

Choose your own temperature level for the program.

If you don't need a third step, just set the outputs to stop signs and set the Wait For time to 0.00.



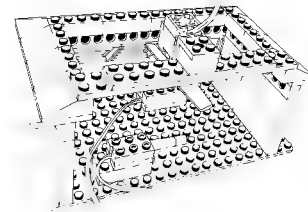
- 6 Download the program and run it. While you are testing your program, use your fingers to warm up the sensor.
- 7 After running the program and gathering the temperature data, go to the Upload page. Click the Plus sign to add a page.
- 8 Upload your data. Select a bin color and name the bin for the data.
- 9 Click on View to see all the data. Select the latest data bin to view just that information.
- 10 Go to the Journal page. Select Describe Page.
- 11 Write a description of what happened when the temperature sensor values changed.

The Ceiling Fan and Temperature Sensor

Learning Objectives

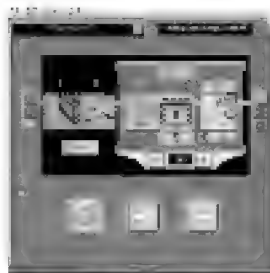
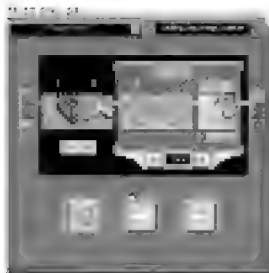
Students will:

- Write a program to make an input control an output using Pilot Level 3.
- Also in the program, capture data from a temperature sensor over time.
- Graph the temperature sensor data.
- Write a report about their project, describing the results.



Discussion

It is a nice idea to use the View option on the RCX display as students are running their programs. That way, they can relate the values they see on the RCX with the graph values.



Students must remember to click the Plus sign to add pages when they want to upload new data. You can see the data in many ways. Here is a chart showing the data points.



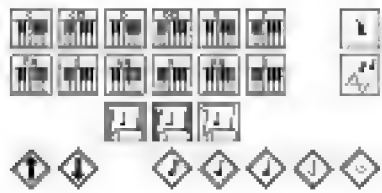
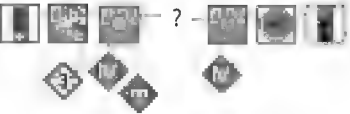
Students can use the Investigator Journal to write about the project. This is an example of the Describe page template showing the Program page.

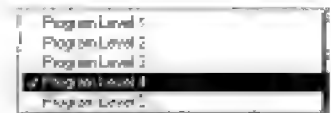
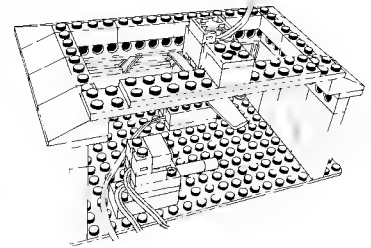


For more information about the Investigator software, see the book *Getting Started 2: Teacher's Guide for ROBOLAB 2.0 Software*.

The Fire Alarm

You are going to create a system to flash a light or sound an alarm when the temperature rises to a dangerous level. Using the Investigator software, you can track the temperature data, view the results, and write a description of what happened.

- 1 Add the temperature sensor and lamp to the house model as shown on page 25 of the Building Booklet.
- 2 Attach the light sensor to port 1 and the lamp to port A. Make sure you attach the temperature sensor to port 3 and the ceiling fan motor to port C.
- 3 Load the **ROBOLAB** software. Select Investigator.
- 4 Click on New Project to create a new project file with your own file name.
- 5 Select Program Level 4. This is an Inventor level of programming.
- 6 Create a program that checks the temperature sensor and sets off the lamp and a sound for an alarm if the temperature increases to a high level. You can use the Temperature Fork  and the Land and Jump icons. 
- 7 You can use the Piano Player or Music icons to program an alarm sound. Add the alarm to your program. 
- 8 Now add to the program so that the temperature sensor data is collected as the program runs. You will have to initialize the temperature sensor first. Remember to modify the icon to check for the temperature sensor on port 3. Use the Start Logging and Stop Logging icons to collect the data. 
- 9 Download the program and try it!
- 10 When you are satisfied that your program works, upload the collected data.
- 11 Download the program and run it. While you are testing your program, use your fingers to warm up the sensor.
- 12 After running the program and gathering the temperature data, go to the Upload page.
- 13 Upload your data. Select a bin color and name the bin for the data.
- 14 Click on View to see all the data. Select the latest data bin to view just that information.
- 15 Go to the Journal page. Select Describe Page.
- 16 Write a description of your program and how it works.



Teacher Notes for use with Set 9795

SECTION 5

INTERMEDIATE AND ADVANCED IDEAS USING INVESTIGATOR PILOT AND INVENTOR

ACTIVITY

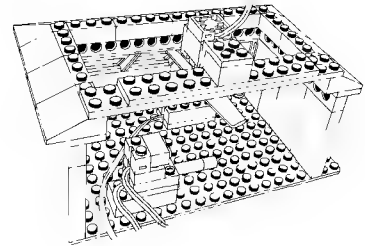
3

The Fire Alarm

Learning Objectives

Students will:

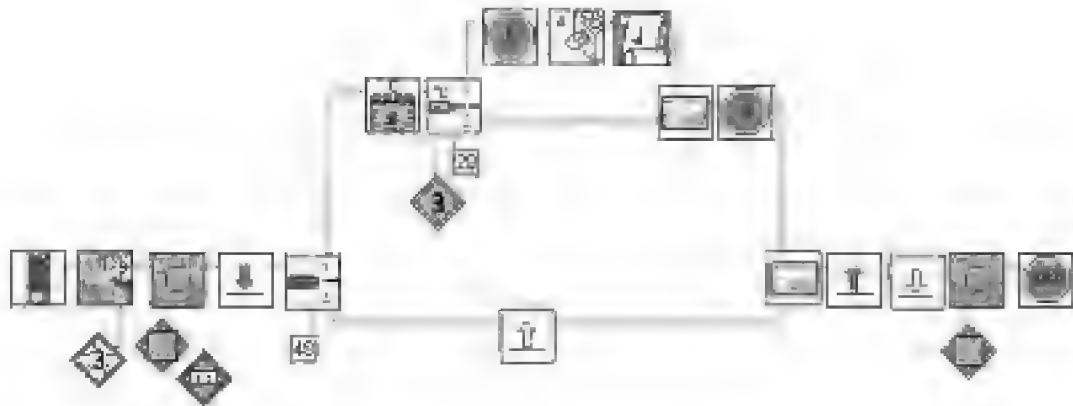
- Write a program to make an input control an output using Inventor Level 4.
- Also in the program, capture data from a temperature sensor over time.
- Graph the temperature sensor data.
- Write a report about their project, describing the results.



Discussion

In the example program below, the temperature sensor is checked with a Temperature Fork. The Land and Jump icons loop so the sensor checks continue until the light sensor is activated.

To gather data, first initialize the sensor and remember to modify it with the correct port number. Here the light sensor is using the default setting of port 1 so it does not need a modifier. However, the temperature sensor icons need to be modified with the port 3 modifiers.

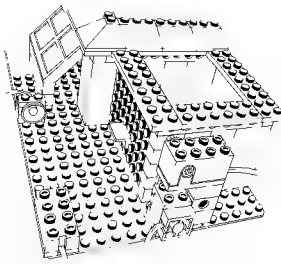


Inventor level programming is preferred here because it allows users to include the Music icons and program their own alarm sounds. See the Doorbell activity in Section 4 for details about using the Piano Player.

For more information about the Investigator software, see the book *Getting Started 2: Teacher's Guide for ROBOLAB 2.0 Software*.

The Garage Door and Angle Sensor

You are going to create an automatic garage door that uses an angle sensor to control the distance the door opens and closes. Using the Investigator software, you can track the angle sensor data, view the results, and write a description of what happened.



- 1 Add the angle sensor to the house model as shown on page 22 of the Building Booklet.

- 2 Make sure you attach the light sensor to port 1, the angle sensor to port 3, the lamp to port A and the motor to port C.

- 3 Load the **ROBOLAB** software. Select Investigator.

- 4 Click on New Project to create a new project file with your own file name.

- 5 Select Program Level 5.



- 6 Program the RCX to collect the light and angle sensor data. Remember to initialize each sensor first and modify them for the correct port. You should also set the angle sensor to zero. Use the Start Logging and Stop Logging icons to control the data collection in the program.



- 7 Now program the garage door to open after the light sensor is activated, then pause and close. Use the angle sensor input to stop the motor the correct distance. The angle sensor fork is helpful here.



- 8 Download the program and try it!

- 9 When you are satisfied that your program works, upload the collected data.

- 10 Upload your data. Select a separate bin for the light sensor and angle sensor data.

- 11 Click on View to see all the data. Select the latest data bin to view just that information.

- 12 Go to the Journal page. Select Describe Page.

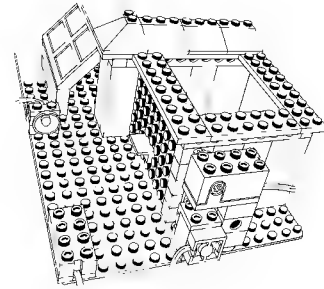
- 13 Write a description explaining how your program works and the data results.

The Garage Door and Angle Sensor

Learning Objectives

Students will:

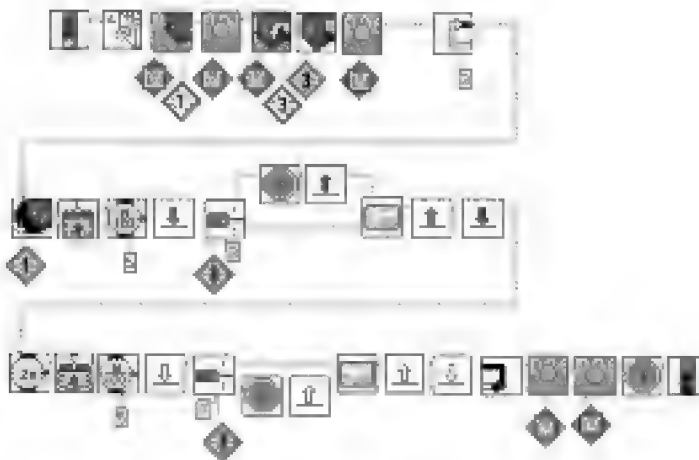
- Write a program to make an input control an output using Inventor Level 5.
- Also in the program, capture data from a light and angle sensor over time.
- Graph the light and angle sensor data.
- Write a report about their project, describing the results.



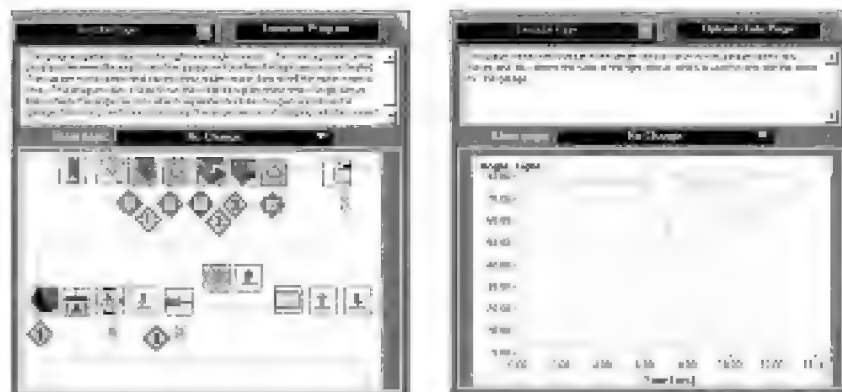
Discussion

In the example program below, the light sensor is checked with a Light Sensor Fork and the angle sensor with the Angle Sensor Fork. The Land and Jump icons loop so the sensor checks continue until the light sensor is activated.

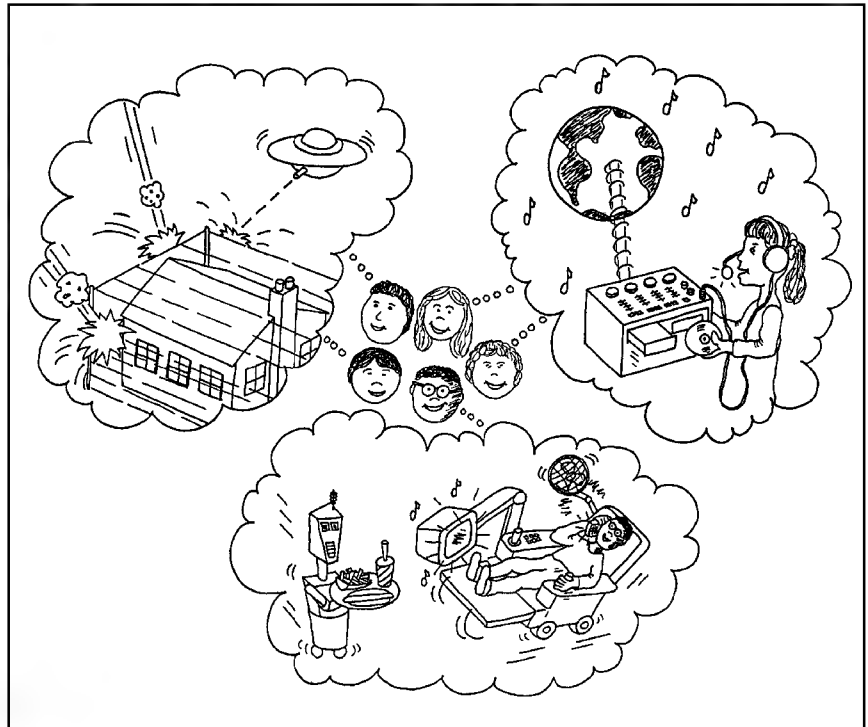
To gather data, first initialize the sensor and remember to modify it with the correct port number. Here the light sensor is using the default setting of port 1 so it does not need a modifier. However, the temperature sensor icons need to be modified with the port 3 modifiers.



The Describe Page template can be used to explain how the system works and the results.



PROJECT **1** **PROJECT**



Overview

This project involves creating a house with futuristic design and technology features to add to the fun, comfort and safety for the inhabitants.

Learning Objectives

In this project students will:

- Work in teams to complete a large group project.
- Work individually on the tasks for which they are responsible.
- Apply the knowledge they have acquired to build and program something they have designed themselves.
- Enhance their individual writing, presentation, negotiation and other communication skills.

Key Subject Areas

LANGUAGE

- Demonstrate writing skills to document their designs and ideas.
- Write creative stories.
- Communicate effectively with others by listening and speaking clearly during team sessions.
- Present their ideas orally using visual aids.

SOCIAL STUDIES

- Demonstrate an understanding of human needs for safety, comfort, and security by designing a home appropriate for people.

GEOGRAPHY

- Demonstrate an understanding of the effect of climate on home design.
- Demonstrate an understanding of the effect of land and water on home design.

MATH

- Measure temperature in degrees Celsius and Fahrenheit
 - Measure rotation (angle)
 - Measure light (%)
 - Calculate distance, perimeter, and area.
 - Understand and use graphed data.
- Produce scaled drawings.

Key Subject Areas

SCIENCE

- Climate data: temperature, light
- Speed
- Cause and effect relationships
- Mechanical engineering principles: using pulleys, gears, motors to make things move

ART/ MUSIC

- Illustrate design ideas
- Demonstrate an understanding of aesthetic

principles: symmetry, balance, and proportion as well as the use of color and the use of other materials to enhance the design

- Adding music using the Piano Player is an option as well.

TECHNOLOGY

- Systems design
- Design and problem solving process skills

Getting Ready

Project Theme

This project is about designing a house that students imagine for the future. The activities in this project involve designing, building and programming new gadgets, scientific instruments and other devices for the comfort, safety, entertainment and convenience of the inhabitants. Therefore, any and all skills the students have learned from using **ROBOLAB** materials before will help them. It is recommended that students are comfortable with Programmer Pilot and Investigator Pilot programming. If possible, it is also a nice idea to have some students who are familiar with Programmer Inventor and Investigator Inventor programming. That way, some of the intermediate or advanced ideas can be developed and programmed.

Background

Our curiosity pushes us to extend our reach as human beings. Technology helps us extend ourselves by making places safer, more comfortable and more fun! Our exploration of remote places on land, under the sea and into space helps us define ourselves, our relationship to other creatures and our place in the universe. These are deep and lasting questions. Imagining the how they will live in the future can help students appreciate the present technology and provide a personal reason to better understand and use technology. The creative writing aspect of the activity can help them brainstorm ideas and provides a framework for deciding which ideas to build and program for the house they design together.

Using the 9795 Building Set

The activities in this project involve using the Intelligent House building set that contains an assortment of building pieces. Other LEGO sets (e.g. the **ROBOLAB** Starter Set #9780 or the Team Challenge Set #9790) can be combined with the Intelligent House set to allow larger, more complex models to be developed. Students can also be

encouraged to use non-LEGO materials to add to their design ideas.

Suggested Resources

Many companies design and manufacture systems for the home. Check out these web sites for technology ideas:

Honeywell
<http://www.honeywell.com>

Siemens and Siemens Solar
<http://www.solarpv.com/>

General Electric
<http://www.ge.com>

Interlogix
<http://www.itii.com/>

Liberate Technologies
<http://www.liberate.com/>

Powergen
<http://www.powergen.co.uk>

ACTIVITY 1

Who Lives Here?

This activity involves brainstorming a list of possible characters who live in the Home of the Future. The students are expected to write a rough draft of a story that includes at least two characters from that list.

- 1 ○ Students need a photocopy of Job Sheet 1: Home of the Future and Job Sheet 2.
- 2 ○ Job Sheet 1 provides the design specifications for the project Who Lives Here?
- 3 ○ On Job Sheet 2, students are told that the style of the written story can be as a creative short story, a play, a newspaper article or a television "infomercial" for the house. You may wish to give explicit instructions on style.

ACTIVITY 2

Home Floor Plan Design

Students can create the floor plan for the house using Job Sheet 3: the Home Floor Plan Design Copymaster. This copymaster has the LEGO studs instead of graph paper so the students can design a home directly to scale.

Note: The copymaster is 24 studs wide by 32 studs high. The baseplate in the building set is 16 studs wide and 32 studs high.

- 1 ○ If you have the LEGO® Designer software, you can have students design their model homes using the computer. Contact LEGO Dacta for more information about LEGO Designer. <http://www.lego.com/dacta>

ACTIVITY 3

Safety, Comfort and Entertainment at Home

In this activity, students use Job Sheet 4 and brainstorm mechanisms or systems they want to create for their Home of the Future. Then they choose 6 of their ideas and describe what sensors, motor and lamps (programmable components) they might want to use to create these mechanisms or systems.

Some possible ideas:

- 1 ○ Personal transportation inside the home e.g. a fast elevator or "moving sidewalk"; or, perhaps they can simulate a new technology like the "transporter device" that transmits people molecule by molecule to some other coordinates.
- 2 ○ Robots to help clean or do other work around the house.
- 3 ○ Earthquake, tornado and hurricane sensors. (Use the LEGO angle sensor to detect motion or use the DCP motion sensor with the LEGO-DCP Microdevelopments Sensor Adapter.)
- 4 ○ Air quality sensors. (This is especially important on a space station!)
- 5 ○ Teleoperational robotic toys or other systems. (See the Programmer sheets for an example of how to use the Internet control features within Robolab.)

ACTIVITY 4

Programming the Home of the Future

Students can use Job Sheet 5 A and 5 B to help them with more advanced programming ideas.

The activities the students completed previously or other solutions shown in the Teacher Notes will also be helpful as a reference.

ACTIVITY 5

Present and Publish Your Home of the Future

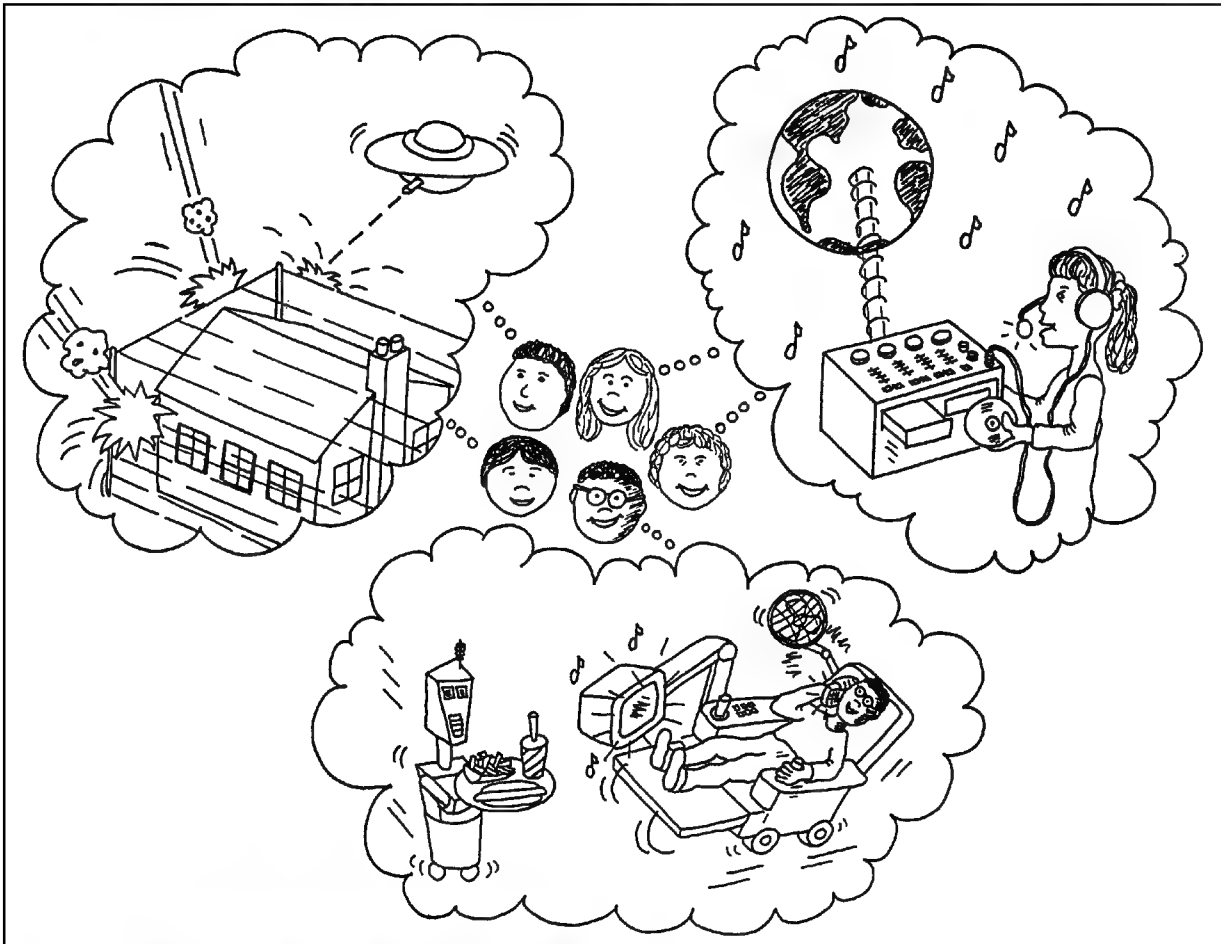
Students can coordinate their final programming and building components, write a final draft of their story and prepare a printed or oral presentation.

- 1 ○ If you have a school web site, you can use **ROBOLAB** to create a multiple web page presentation which you can then post.
- 2 ○ Contact LEGO Dacta to share your projects. You can e-mail us your web site url so we can add it to the LEGO Dacta web search database. That way, teachers and students who are searching for good ideas in the LEGO Dacta Invent & Investigate database can visit your site!
- 3 ○ To go to the Invent & Investigate database, <http://www.lego.com/dacta/robolab/i2resources>
- 4 ○ To tell LEGO Dacta about your web site, send the url to this e-mail address:
robolab@ix.netcom.com

GROUP _____

DATE _____

Home of the Future



The Design Brief

Design and build the ideal home of the future with the safest, most comfortable and most fun surroundings.

Remember to:

- Create a story about the people who live in the home, what they do and how they live.
- Create a floor plan with space for the new technologies you invent for the people who live there.
- Agree on which technologies you will build and program for the home and where they will be located inside the home.
- Include at least one safety feature, one comfort feature and one entertainment feature.
- Include any other features you like using LEGO or other materials.
- Present your story to the class and demonstrate the features you have designed and made.

GROUP _____

DATE _____

Who Lives Here?

- 1 ☐ Brainstorm a list of who lives in your Home of the Future.

- How many people live here?

- What are their names?

- How old are they?

- What do they do?

- Choose 3 things about them that are important.

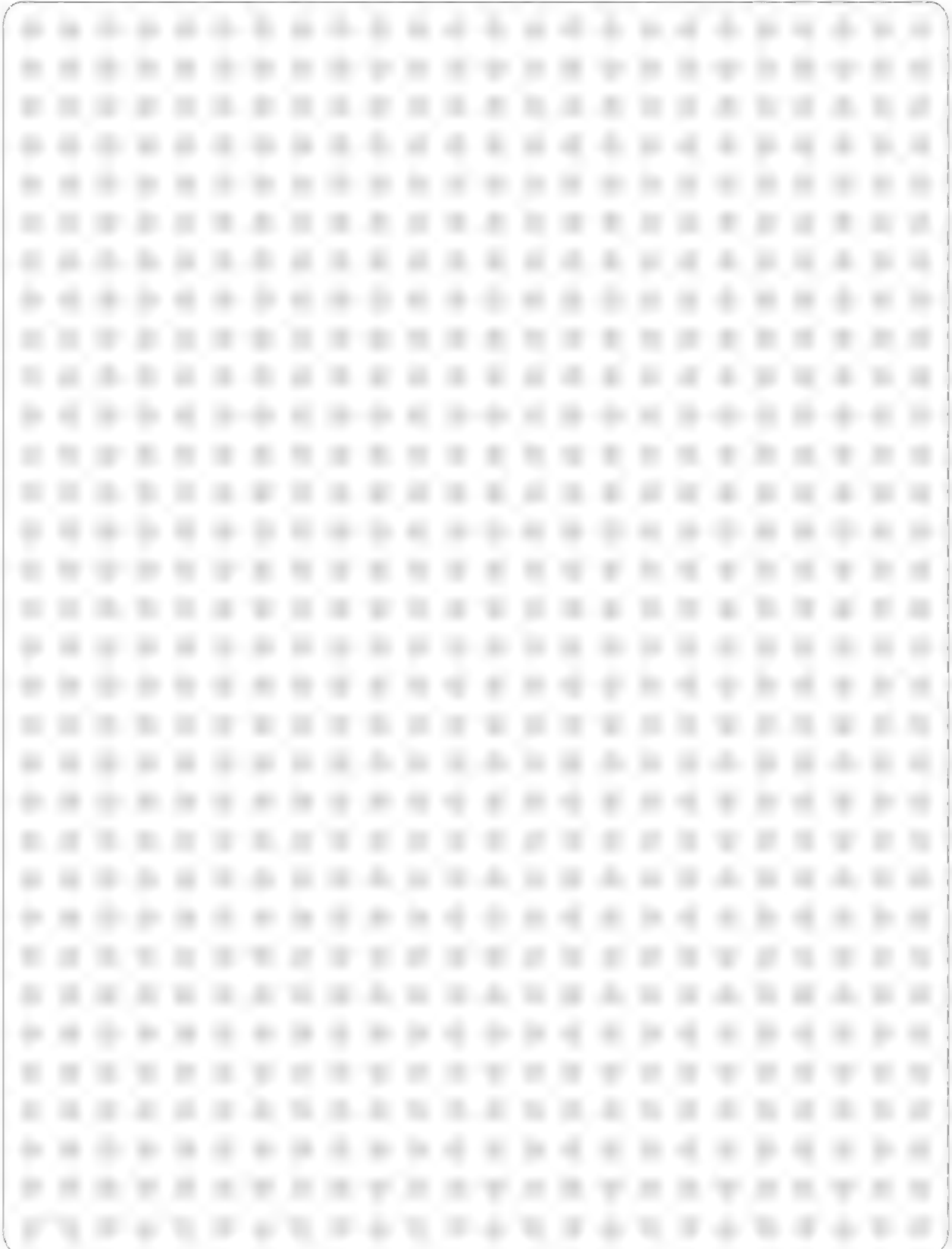
- 2 ☐ Now create an outline or rough draft of a story about these characters. The style of the written story can be as a creative short story, a play, a newspaper article or a television "infomercial" for the house.

The story must include:

- At least two characters you created above.
- An initial description of the Home of the Future the characters live in.
- An initial description of the kinds of futuristic devices that are in the house.

Home of the Future

Draw a LEGO floor plan.



GROUP _____

DATE _____

Safety, Comfort and Entertainment at Home

- 1 Brainstorm a list of things that the people in the house can do or can control in your Home of the Future. Think about:

- How will they communicate amongst themselves and with other people not in the home?
- How do they prepare their food?
- What type of security devices protect them?
- How do they travel from room to room and outside their home?
- How do they control the temperature, light and other comfort features of their home?
- What do they do for music, art, and entertainment?
- Maybe this house is actually the space station module designed as a living quarters. What special equipment would be needed?

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

- 2 Using all the available Intelligent House materials to the group, consider the ideas from the brainstorming session and plan what computer-controlled devices might be in your Home of the Future. Choose 6 and describe what sensors, motors and/ or lamps might be used.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

GROUP _____

DATE _____

Programming the Home of the Future

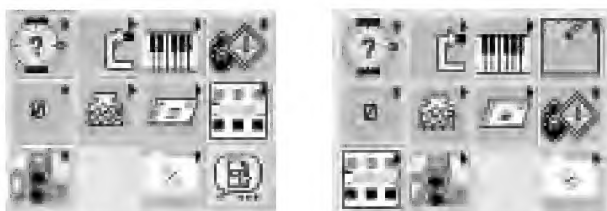
Make your Home of the Future more “futuristic” by controlling some of the RCX functions over the Internet. The programs you write can be downloaded to an RCX located near a computer running **ROBOLAB** that is linked through the Internet. The two computers can be in the same room or almost anywhere in the world!

Note: you need two computers and an Internet connection with a known IP address. One computer must have the IR Transmitter and RCX set up and ready to go. If you have not tried this before, see the online documentation, Internet Control of the RCX. You can download it from <http://www.lego.com/dacta/robolab/>. Click on Resources then Downloads.

- 1 First set up the **ROBOLAB** Server computer and the RCX with the Home of the Future model you want to control. To start the **ROBOLAB** Server software, navigate to the **ROBOLAB/Extras** folder and double click on **ROBOLAB** Server. After starting the **ROBOLAB** Server, the computer and RCX are ready to receive programs over the Internet.



- 2 Now you can use the Internet sub menu of the Programmer - Inventor Level 4 or in the Investigator - Program Level 5 to create programs for controlling your Home of the Future.



You can create new programs or adapt existing programs to the Internet mode. Every program that you to send over the Internet to an RCX must use the Internet Begin and End commands.



The Internet Begin command is used instead of the standard Begin command in ROBOLAB programs. The IP address of the remote computer that will be transmitting the program to the RCX must be specified. The remote computer must be running ROBOLAB Server.



The Internet End command is used at the end of every Investigator or Inventor Internet program that begins with the Internet Begin Command.

GROUP _____

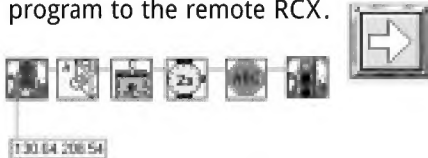
DATE _____

Programming the Home of the Future

The String modifier is used to specify the IP address of the remote computer. 

You send the program over the Internet the same way you download: by pressing the Run arrow on the ROBOLAB screen.

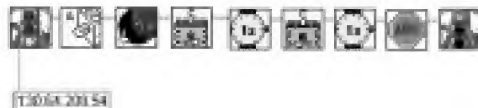
- 3 Here is a program that turns on the lamp in port A and turns on a motorized machine attached to port C. The lamp and motor stay on for two seconds, then turn off. This program is sent to the remote computer with IP address 130.64.208.54. The remote computer then downloads the program to the remote RCX.



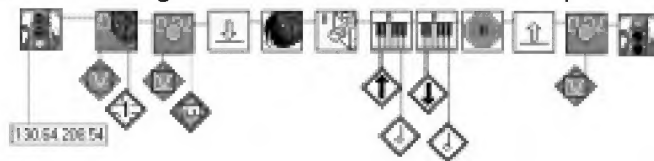
*Note: The remote computer must be running the **ROBOLAB** Server and have an IR Transmitter attached with the remote RCX on and nearby.*

After the program is downloaded to the remote RCX, someone must press the Run button on the RCX to start the program.

- 4 Here is a program that controls the automatic garage door. First, the lamp across from the light sensor turns on. When the car going past activates the light sensor, the garage door opens and closes.



- 5 Here is an example of a security system program that you can download from the local computer to a remote computer (that is running ROBOLAB Server). If someone activates the light sensor, the lamp turns on and an alarm noise sounds. This program was created in Investigator - Program Level 5 so the data from the light sensor is collected and can be uploaded.

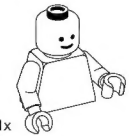
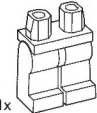
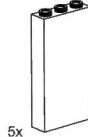
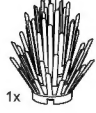


- 6 You can also send programs over the Internet to the RCX to control the RCX directly. That means the RCX runs the program immediately - it does not wait for someone to press the Run button. To create an Internet Direct Mode program, replace the Internet Begin and Internet End commands with the Begin Internet Direct Mode and End Internet Direct Mode commands.

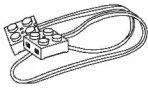
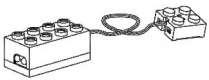
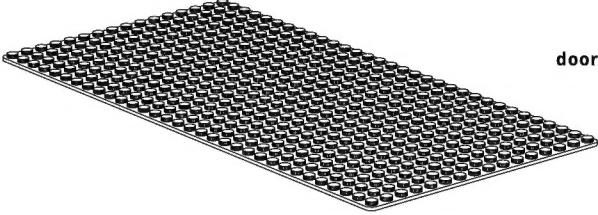
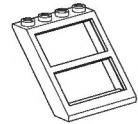


*Note: Programs for Internet control of the RCX can be as complex as any of the conventional RCX programs for your local computer. There are a few exceptions - **ROBOLAB** Server does not support Internet Direct Mode for programs with Data Acquisition or Looping structures. However, these formats are supported by the Internet Mode.*

SECTION 7 9795 PARTS INVENTORY

Boy wig	1x 	1-stud transparent plate	2x 
Girl wig	1x 	1x2 plate	1x 
Minifigure upper body	1x 	1x3 plate	2x 
Minifigure legs	1x 	1x4 plate	4x 
1x2 beam	6x 	1x8 plate	1x 
1x6 beam	1x 	2x2 plate	1x 
1x8 beam	1x 	2x3 plate	1x 
1x10 beam	2x 	2x6 plate	3x 
1x12 beam	1x 	2x12 plate	5x 
1x1x2 corner brick	2x 	2x16 plate	1x 
1-stud brick	1x 	6x8 plate	1x 
1x2 brick	11x 	2x2 angle plate	1x 
1x2 transparent brick	1x 	1x2.5 hinge bottom	2x 
1x8 brick	2x 	1x2.5 hinge top	2x 
2x2 round brick	1x 	1x2 handle	1x 
2x2 brick	2x 	parasol or satellite dish	1x 
2x4 brick	1x 	2x2 round plate	2x 
1x2x5 wall	7x 	2x2 bearing plate	2x 
1x3x5 wall	5x 	2x2 tile	5x 
shrub	1x 	2x3 plate with holes	4x 

SECTION 7 9795 PARTS INVENTORY

1x4 front bumper	1x 	pulley	1x 
1x2 plate with steering wheel	1x 	axle extender	1x 
2x4 back bumper	1x 	bushing	4x 
car chassis with axles	1x 	catch	1x 
tire/tyre	4x 	cross axle with stop	1x 
2x2 micromotor adapter top	1x 	connector peg	4x 
micromotor	1x 	24-tooth crown gear	1x 
2x2 micromotor adapter bottom	1x 	8-tooth gear	1x 
pulley (attaches to micromotor)	2x 	2-stud axle	1x 
blue belt	2x 	4-stud axle	2x 
lamp	1x 	8-stud axle	1x 
parabolic reflector for lamp	1x 	1x3 roof brick	2x 
spiral for connecting leads (wires)	5x 	3x3 roof brick	8x 
connecting lead (wire) 52 cm	1x 	4x3 roof brick	2x 
connecting lead (wire) 128 cm	2x 	corner roof brick	2x 
light sensor	1x 	propeller	2x 
16 x 32 stud building plate	1x 	angled window	2x 
		door	1x 